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ABSTRACT

Variables to predict grades in a noncalculus, preprofessional college physics course at Xavier University of Louisiana, a historically-black institution, were identified using linear regression. The two-semester, noncalculus physics course emphasizes the application of physics in the health professions. The study population consisted of 123 students majoring in biology, chemistry, or prepharmacy who enrolled in the first-semester physics course. Of this number, 104 enrolled in the second-semester physics course. It was found that high school grade point average was the best predictor of grade in the first semester of physics and that the accuracy of prediction could be improved by adding either the American College Testing program (ACT) composite score or ACT English score. The best predictor of grade in the second-semester of physics was determined to be grade in the first-semester course. Inclusion of high school grade point average and scores on the Nelson-Denny Reading Exam improved grade prediction. It was recommended that different predictive procedures be used for black males and females. (SW)

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PREDICTORS OF GRADES FOR BLACK AMERICANS IN A NON-CALCULUS, PREPROFESSIONAL PHYSICS SEQUENCE

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Abstract: There is a national need to address the underrepresentation of blacks in the health professions, since such underrepresentation is directly related to the relatively poor health care available to black America. One factor which limits efforts to increase the number of black health professionals is performance in science courses at the college level. The current investigation used linear regression techniques to identify variables which predict grades in a non-calculus, preprofessional college physics course at Xavier University of Louisiana, a historically-black institution. It was found that high school grade point average was the best predictor of grade in the first semester of physics (r=0.451), and that the accuracy of prediction could be improved by adding either ACT Composite or ACT English score. The best predictor of grade in the second-semester of physics was determined (as expected) to be grade in the first-semester course (r=0.577) with inclusion of high school grade point average and scores on the Nelson-Denny Reading Exam providing improvement in prediction. It is anticipated that this and similar studies will make it possible to improve advising/placement of students, and provide direction in developing intervention strategies to help the underprepared.

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PREDICTORS OF GRADES FOR BLACK AMERICANS IN A NON-CALCULUS, PREPROFESSIONAL PHYSICS SEQUENCE

Many students interested in health careers fail to achieve their career goals because of inability to perform adequately in science courses such as physics. While this problem is of concern in any populace, it is particularly devastating to minority groups such as black Americans who are severely underrepresented in the health sciences because underrepresentation impinges on the quality and availability of primary health care in black communities. Davis and Davidson (1982) state that "minority health providers, particularly physicians, are more likely to serve minority patients for a variety of reasons. Consequently the shortage of minority health practitioners has a direct negative effect on minority communities." The magnitude of the problem is illustrated by noting that although the US Government (1978) currently estimates the percentage of blacks in the nation's populace to be approximately 12%, the Association of Minority Health Professions Schools (1983) has found that less than 2.5% of the nation's health professionals are black. There is thus an urgent need to improve the performance of blacks in physics as one step in the effort to increase black representation in the health professions thereby improving the health care provided black America.

If there is to be significant progress toward reaching the goal of increasing the number of black Americans in health

fields, both predominantly black and majority institutions must be involved in the effort. The potential role of the predominantly black colleges is indicated by the fact that while they enrolled only 17% of black Americans in college in the late 1970's, they awarded 37% of the baccalaureate degrees received by blacks nationwide and more than 50% of such degrees in states where the traditionally black colleges are located (National Advisory Committee for Black Higher Education and Black Colleges and Universities, 1980). Of particular value in the effort to increase the access of blacks to health careers are studies of factors which impinge upon achievement of blacks in physics and related science courses. This paper describes one such effort, a study of predictors for success of black Americans interested in the health professions in non-calculus physics at Xavier University of Louisiana, a small predominantly black institution in New Orleans. It is one of a number of studies at Xavier initiated to improve advising of students interested in the health professions and to provide direction in developing intervention strategies to help those who are underprepared.

Overview

Xavier University of Louisiana (XU) is a Catholic, liberal arts institution requiring 56 semester-hours of history, art, philosophy, etc. for graduation. Although a typical liberal arts institution in philosophy, Xavier does not have the enrollment pattern of the typical liberal arts institution. Approximately 50% of the 1,600 (or so) full-time undergraduates at Xavier are

in majors designed to lead into a health profession. The University places from 65 to 75 Blacks into health professions school yearly, is regularly #1 in the United States in placing black Americans into colleges of pharmacy, and is consistently one of the top five schools in the nation in placing blacks into medical school. Xavier is thus particularly appropriate for studies of the performance of blacks interested in the health professions in college-level physics courses.

All students interested in the health professions at Xavier must complete a two-semester, non-calculus physics sequence, Physics 2010 and 2020. As a prerequisite to entry into Physics 2010, students must either complete a four semester-hour Precalculus course with a "C" or better or demonstrate sufficient competence in algebra and trigonometry to by-pass Precalculus upon entering Xavier. Most students take physics during either the sophomore or junior years at Xavier. Class sizes range from 60 to 80 per section in lecture and are limited to 24 in laboratory. Students are required to purchase both a traditional text and a locally-produced workbook consisting of short modules containing learning goals, specific homework/reading assignments, a list of alternative learning aids available, and sample exams. The course emphasizes the application of physics in the health professions, while covering the traditional content for non-calculus based physics. The text currently in use is Principles of Physics by Bueche (1982).

There have been a number of previous studies of a related nature. Hudson and McIntire (1977) reported weak correlation between performance in introductory non-calculus physics and mathematics skills at the beginning of the course, and concluded that such skills alone are not sufficient to guarantee success in physics. In a more comprehensive, related study, Hudson and Rottman (1981) found significant correlation (r=0.418) between score on a pre-course test of algebraic/trigonometric skills and performance in non-calculus, preprofessional physics for those who completed the course. It was also noted, however, that no such relationship existed between mathematical skills and whether or not the student completed or dropped from the course. Wollman and Lawrenz (1984) subsequently verified both the correlation between mathematics skills at the time of entry into the course and achievement in non-calculus physics for those who completed the course, and the fact that such skills could not be used to predict who would drop out. In addition, they discovered that ability to predict physics grade from a mathematics skills pre-test could be improved by using a multiple regression procedure which added total grade point average and score on the Natural Science subsection of the ACT. The relationship between mathematical skills and performance in physics has also be verified by Crooks (1981), O'Halloran and Russell (1980), and Hudson and Liberman (1982).

While the above studies provide direction for the present investigation, there is some questions regarding their

relationship since all studied populaces at majority institutions without specifically considering the performance of black Americans. This is of particular concern because Temp (1971) and Borgen (1972) have found that traditional admissions variables (such as high school grade point average and SAT scores) predict the performance of black students at predominantly white institutions considerably less accurately than they predict the performance of white students at those same institutions. On the other hand, Hills (1964), McKelpin (1965) and Stanley and Porter (1967) reported that traditional variables predicted overall college grades of black students at predominantly black colleges reasonably well, and Joyner (1973) found that there was a significant relationship between scores on the Nelson-Denny Reading Test and grades of black freshmen college students. Also of potential interest are recent studies by Hunter (1984) and Carmichael, et al (1986) which determined that a combination of ACT composite score and high school grade point average was a good predictor of success of blacks in the first semester of both freshman biology and chemistry at Xavier and that the first semester grade is a good predictor of second semester grade in both sequences. Finally, Sample and Seymour (1971) and Farver, et al (1973) found evidence that traditional criteria were less successful in predicting the academic performance of black males than that of black females.

These studies suggest a number of questions to consider in the present investigation.

(1) Can performance of black Americans in non-calculus, preprofessional physics at a traditionally black institution be predicted? If so, what is the best predictive procedure?

(2) Does predictive power for black males vary from that for black females?

(3) What implications can be drawn from comparison of this study with past investigations?

Procedure

Students interested in the health sciences at XU take a two-semester, non-calculus based sequence, Physics 2010 and 2020. Eleven variables were chosen as potential predictors of grade in Physics 2010. These included participation in a special, pre-matriculation, problem-solving oriented summer program entitled "SOAR" (Carmichael, 1982) and ten readily available, traditional variables available at time of admission to the University: high school grade point average (GPA) on a 4.0 scale, ACT score (Mathematics, English, Natural Science, Social Science, and Composite), scores on the Nelson-Denny Reading Test (Vocabulary, Comprehension and Total in grade level equivalents), and sex of the student. Grade in Physics 2010 was added to the list of predictors in the study of Physics 2020 grade. The number of students who dropped from the courses (9 from Physics 2010 and 4 from Physics 2020) was too small to be useful in studying the factors which predict this phenomenon. Therefore, they were excluded from the study. It should be noted that "dropout" at XU may be different from that at other schools,

because the University does not permit withdrawal from courses after the end of the first week following midterm.

The population under study consisted of those students entering Xavier as freshmen and majoring in biology, chemistry, or pre-pharmacy in the fall semesters of 1981, 1982, or 1983 who took physics from 1982 through 1985. Of these students, 123 (79 females and 44 males) enrolled in first semester physics and were used in this study. The remainder did not present ACT scores when applying to the University or dropped from the "prehealth" majors under study before enrolling in physics. Of the 123 total, 88 (56 females and 32 males) completed Precalculus before enrolling in Physics 2010, whereas 35 (23 females and 12 males) bypassed Precalculus on the basis of performance on a mathematics placement exam. 104 (69 females and 35 males) of the original 127 subsequently enrolled in Physics 2020. 77 (50 females and 27 males) of the 104 were from the group of 88 who had taken Precalculus and the remaining 27 (19 females and 8 males) were from the group who had bypassed Precalculus. Students in all three prehealth majors are scheduled to take the required physics sequence during either the sophomore or junior year and most took it at one of those levels. Although some students repeat one or more of the required courses, only the grade from the first attempt was used in this study.

Results

Analyses were performed using the Statistical Package for the Social Sciences (SPSS)--Version 9. First, means and standard

deviations were obtained for all variables associated with Physics 2010 and 2020. Numerical values were substituted for the alphabetical values of Physics 2010 and 2020 grades (A=4, B=3, C=2, D=1, and F=0 where "W" grades were ignored) and dummy variables were introduced for sex (Male=1 and Female=0) and participation in SOAR (Yes=1 and No=0). Results are summarized in Table 1 for various subgroups.

Table 1--Means and Standard Deviations of Predictors for Students in Physics 2010 and 2020

Variables	Physics 2010				Physics 2020			
	Total (N = 123)		w/Precalc (N = 88)		Total (N = 104)		w/Precalc (N = 77)	
	Mean	Stnd Dev.	Mean	Stnd Dev.	Mean	Stnd Dev.	Mean	Stnd Dev.
Physics 2010 Grade	2.25	0.96	2.12	0.88	2.39	0.88	2.21	0.85
Physics 2020 Grade	----	----	----	----	2.22	0.90	2.12	0.83
High School GPA	3.06	0.62	3.02	0.63	3.12	0.64	3.06	0.64
ACT Composite	18.7	4.9	18.1	4.7	19.1	4.8	18.3	4.6
ACT English	18.0	6.5	17.0	6.0	18.7	6.1	17.5	5.6
ACT Mathematics	18.8	5.1	18.0	5.0	19.0	5.0	18.1	4.9
ACT Natural Science	20.4	5.4	19.8	5.5	20.7	5.4	19.9	5.5
ACT Social Science	16.9	6.4	16.7	6.3	17.3	6.4	16.9	6.4
Nelson-Denny Vocab.	13.3	2.4	13.3	2.4	13.5	2.3	13.4	2.4
Nelson-Denny Comp.	13.4	2.4	13.4	2.4	13.6	2.2	13.5	2.3
Nelson-Denny Total	13.4	2.3	13.4	2.2	13.6	2.1	13.5	2.1
Sex (F=0, M=1)	0.36	0.48	0.36	0.48	0.34	0.48	0.35	0.48
SOAR (Yes=1, No=0)	0.56	0.50	0.52	0.50	0.59	0.50	0.54	0.50

While the numerical values are generally self-explanatory, some observations might be made. The ACT Composite scores for students in this study were probably below the mean of those in other institutions in similar courses at the time, since the mean ACT of XU's freshmen during these years was about 16, slightly below the 17+ mean of freshmen in the Southwest and South/Southeast (American College Testing Service, 1983).

Similarly, reading scores might be slightly below those of students at other institutions, since the entering reading levels for XU's prehealth freshmen were generally about ~1/2 grade level below the expected 13th grade level. Means less than 0.5 for the sex variable reflect the fact that there were more female than male students in the study, a distribution by sex that was representative of the class and XU as a whole. The relatively constant mean for the sex variable from first to second semester indicates that attrition of females was approximately the same as that of males. Approximate values of 0.5 for "SOAR" indicate that approximately 50% of the group of students had participated in the problem-solving summer program. The increase in the means of the academically related variables from first to second semester is not surprising, since normal academic selection would be expected to eliminate more of those with lower scores. Similarly, as expected, students who by-passed Precalculus had higher means for academic criteria when entering XU than those who did not.

Next, Pearson correlation coefficients between the Physics 2010 and 2020 grades and each of the potential predictor variables were calculated for the total group taking each course. These correlations are presented in Table 2.

Table 2--Correlation Coefficients (r) Between Physics 2010 and 2020 Grades and Each of the Independent Variables

Independent Variable	r with Physics 2010 (N = 123)	r with Physics 2020 (N = 104)
Physics 2010 Grade	-----	0.577
High School GPA	0.451	0.407
ACT Composite	0.404	0.319
ACT English	0.405	0.287
ACT Mathematics	0.259	0.255
ACT Natural Science	0.326	0.201
ACT Social Science	0.323	0.276
Nelson-Denny Vocabulary	0.352	0.064
Nelson-Denny Comprehension	0.280	0.089
Nelson-Denny Total	0.325	0.074
Sex	0.034	0.074
SOAR	0.318	0.163

The best single predictor of physics grade for the total group of 123 was high school grade point average with an r of 0.451 (r^2 equals 0.203, indicating that 20.3% of the variance in physics grade was accounted for by this predictor). For this group, both ACT Composite and ACT English score also had r values above 0.4. In addition, it is noted that there is relatively low correlation between grade in Physics 2010 and either ACT Mathematics or ACT Natural Science score. As expected, grade in Physics 2010 was the best single predictor of grade in Physics 2020 ($r=0.577$). Of the traditional variables available at time of admission to the University, high school grade point average was the single best predictor of Physics 2020 grade ($r=0.407$), as it was of Physics 2010 grade. However, correlation of high school grade point average with grade in the second semester course was somewhat lower than with grade in the first semester course.

Multiple linear regressions were then completed for both Physics 2010 and 2020 to determine if combinations of the variables would improve ability to predict grade. Because there was a high degree of correlation between the composites for ACT and the Nelson-Denny Test and their respective components (a circumstance which indicates that regression procedures might not be applicable if both were included), analyses for composites and components were conducted separately. In each analysis, variables were added one at a time so as to obtain the maximum increase in the multiple correlation coefficient R at each step, until adding more terms failed to produce a statistically significant improvement at the 0.05 level. The results of the various multiple linear regressions are summarized in Table 3. For each, the probability that the R value occurred by chance was less than 0.001.

Table 3--Summary of the Stepwise Multiple Linear Regression Analyses for Physics 2010 and Physics 2020

For Physics 2010

Student Group	Predictors included	Step	Variable Added	R	R^2 x 100%	R^2 x100%
Total (N=123)	Composites	1	HS GPA	0.451	20.3%	----
		2	ACT Comp	0.490	24.1%	3.8%
		3	SOAR	0.518	26.8%	2.7%
	Components	1	HS GPA	0.451	20.3%	----
		2	ACT Engl	0.511	26.1%	5.8%
		3	SOAR	0.536	28.7%	2.6%

For Physics 2020

Student Group	Predictors included	Step	Variable Added	R	R^2 x 100%	R^2 x 100%
Total (N=104)	Composites	1	P2010 Grd	0.577	33.3%	----
		2	HS GPA	0.601	36.1%	2.8%
		3	N-D Total	0.624	38.9%	2.8%
		4	ACT Comp	0.643	41.4%	2.5%
	Components	1	P2010 Grd	0.577	33.3%	----
		2	HS GPA	0.601	36.1%	2.8%
		3	N-D Vocab	0.624	38.9%	2.8%

These analyses indicated that high school grade point average was a relatively good predictor of Physics 2010 grade (R=0.451, accounting for 20.3% of the variance in physics grade) and that prediction was improved by adding either ACT Composite or ACT English scores. Inclusion of the ACT Composite score increased R to 0.490 to account for 24.1% of the observed variance, an improvement of 3.8% over use of high school grade point average alone. Adding the ACT English score increased R to 0.511 to account for 26.1% of the variance (a 5.8% improvement). In both cases, the percentage of variance in physics grades

explained by predictor variables increased by slightly more than 2.5% on further inclusion of the dummy variable denoting participation in the summer bridge program (SOAR).

The best predictors of grade for students who completed Physics 2020 was grade in Physics 2010 (R=0.577, to account for 33.3% of the variance). Addition of high school grade point average improved the ability to predict Physics 2020 grade; R increased to 0.601 to account for 36.1% of the variance (a 2.8% increase). Further improvement was obtained by adding either Total or Vocabulary score on the Nelson-Denny Reading Test; R increased to 0.601 to account for 38.9% of the variance (a 2.8% increase). Finally, if Nelson-Denny Total score was used, it was possible to obtain an additional improvement in R to 0.643 (41.4% of total variance, a 2.5% increase) by adding ACT Composite.

Next, since previous investigations had indicated that traditional criteria were less useful in predicting the academic performance of black males than of black females, means for the predictive variables and correlation coefficients with Physics 2010 and 2020 were calculated for females and males separately for each of the total groups. The results are summarized in Table 4.

Table 4--Means of Independent Variables and Correlation Coefficients (r) with Physics 2010 Grade for Females and Males Separately

Independent Variable	Physics 2010 F (N=79) Mean	Physics 2010 F (N=79) r with P2010	Physics 2010 M (N=44) Mean	Physics 2010 M (N=44) r with P2010	Physics 2020 F (N=69) Mean	Physics 2020 F (N=69) r with P2020	Physics 2020 M (N=35) Mean	Physics 2020 M (N=35) r with P2020
Physics 2010 Grade	2.23	-----	2.30	-----	2.38	0.615	2.43	0.490
Physics 2020 Grade	-----	-----	-----	-----	2.17	-----	2.31	-----
High School GPA	3.16	0.521	2.88	0.391	3.21	0.473	2.95	0.367
ACT Composite	18.9	0.393	18.2	0.441	19.4	0.414	18.3	0.116
ACT English	17.6	0.343	18.7	0.553	18.4	0.320	19.6	0.215
ACT Mathematics	19.5	0.228	17.6	0.359	19.8	0.321	17.6	0.203
ACT Nat. Science	20.6	0.351	20.0	0.274	21.1	0.313	19.9	-0.034
ACT Soc. Science	17.3	0.344	16.2	0.290	18.1	0.403	16.0	0.032
Nelson-Denny Vocab	13.4	0.301	13.1	0.457	13.6	0.070	13.5	0.091
Nelson-Denny Comp.	13.6	0.247	13.0	0.365	13.7	0.118	13.5	0.060
Nelson-Denny Total	13.6	0.267	13.1	0.451	13.7	0.072	13.5	0.087
SOAR	0.53	0.292	0.61	0.367	0.56	0.166	0.63	0.144

Although the relatively small number of students in the subgroups indicates that caution should be used in interpreting the results, the data in Table 4 seem to indicate performance of black males in physics can probably be predicted as well as that of black females. However, the apparent differences in strength of correlation for males and females may indicate that the best predictive procedure for the two are different. As expected, grade in first semester physics is the best single predictor for grade in Physics 2020 for both females and males. The small size of the sample may account for the differences in magnitudes ot the values of r. This would be in agreement with studies in freshman biology and chemistry at Xavier (Hunter, 1984; Carmichael, et al, 1986) in which it was found that both first and second semester grade could be predicted as accurately for black males as for black females from a common procedure.

Combinations of ACT Composite score and high school grade point average were found to predict first-semester grade in both the biology and chemistry sequence, and in both first semester grade predicted grade in the followup course.

Finally, analyses similar to the above were conducted for the subgroups who had taken Precalculus before enrolling in physics. These analyses yielded no additional information of interest. The results were less reliable because of reduced sample size and correlation coefficients between the various predictor variables and grades were generally lower than for the total sample for both Physics 2010 and 2020. The only new data obtained were correlation coefficients between grade in the prerequisite Precalculus course ~and grades in the two physics courses. These were very low. R between Precalculus grade and Physics 2010 grade was 0.208 and that with Physics 2020 grade was 0.239.

Discussion

(1) Can traditional variables predict performance of black Americans interested in the health professions in non-calculus, preprofessional physics at a traditionally black institution? If so, what is the predictive procedure?

A number of the variables included in the present study were found to have value in predicting grade of Black Americans in the first-semester of non-calculus physics. The best predictor for the total group was high school grade point average but other variables, particularly ACT Composite and ACT English scores,

also had high enough correlation to be of use. All were in the same range as the 0.418 found between mathematics skills and physics achievement by Hudson and Rottman (1981) and the 0.461 determined by Wollman and Lawrenz (1984). Further, although high school grade point average and ACT Composite were also found to be good predictors of first semester grade in biology (Hunter, 1984) and chemistry (Carmichael, et al, 1986) at Xavier, they predict more accurately for these freshman-level courses than for physics. In biology and general chemistry, either could account for 25% or more of the variance in first-semester grade, versus 20% or so in physics. This result is not unexpected, since it is reasonable to expect that high school data will predict better for courses taken closer in time to the high school years.

Subsequent stepwise multiple regression analyses for the entire group indicated that ability to predict Physics 2010 grade could be improved by using a linear combination of high school grade point average and either ACT Composite or ACT English score (increasing the percentage of variance explained to 49.0% or 51.1%, respectively). None of the other variables produced a statistically significant increase in accuracy of prediction of Physics 2010 grade except the "SOAR" variable. This variable increased the percentage of variance explained by about 2.5%, which indicated that students who participated in the summer bridge program (Carmichael, 1982) before entry into Xavier performed better in Physics 2010 than those who did not. The total equation predicted first semester physics grade somewhat

less accurately (R=0.518 for ACT Composite and 0.536 for ACT English) than for biology (R=0.640) or general chemistry (R=0.641), in agreement with the assumption that high school variables are less useful in upper level courses.

The best predictor of second semester physics grade for the entire group was found, as expected, to be grade in the first semester course. Further, ability to predict grade from a single variable was somewhat better for the second than for the first semester course (25% or more of the variance in second term grade is explained). Both findings are in agreement with the studies in freshman biology and chemistry at XU. The strength of correlation between first and semester grades in physics (where r=0.577 for the total group) was slightly higher than in biology (r=0.546), but lower than in chemistry (r=0.671).

Stepwise multiple regression analyses for the total group in Physics 2020 indicated that ability to predict Physics 2020 grade could be improved by adding high school grade point average to the predictor equation, and improved again by adding either Nelson-Denny Reading Total or Vocabulary scores. The multiple correlation rose to 0.624 using either. Finally, an additional improvement (to R=0.643) could be obtained if ACT Composite score were used with the set which includes Nelson-Denny Reading Total score. Either of the two equations for predicting Physics 2020 grade were somewhat more accurate that for the second semester of biology (R=0.566) and slightly less accurate than that for second-semester chemistry (R=0.690).

Case by case comparison of predicated with actual grade (rounded off to the nearest grade) showed that the equation for the total group for Physics 2010 predicted grades correctly 49% of the time and was in error by only one letter grade an additional 48% of the time. The equation for all students in Physics 2020 predicted grades correctly for 46% of the students, and was in error by one letter grade for an additional 42%.

In accord with previous studies by Hudson and McIntire (1977), Hudson and Rottman (1981), and Wollman and Lawrenz (1984), there was a relatively weak correlation between measures of mathematical preparation and ability (ACT Math score and Mathematics 1030 grade) with grade in Physics. It appears that math skills are necessary but not sufficient for success in Physics.

(2) Does predictive power for black males vary from that of black females?

The relatively small numbers in the studies when females and males were treated separately make any conclusions regarding differences suspect. However, this study suggests that the grades of black males in physics can probably be predicted as accurately as can grades of black females, but that the accuracy of prediction may be improved by using different predictive procedures for the two. It should be noted that these findings are in contrast to previous studies at Xavier, in which it was found that grades for males in both first-year biology (Hunter, 1984) and first-year chemistry (Carmichael et al, 1986) could be

predicted from single predictive equations as accurately as could the grades of females. Even so, one cannot discount the possibility that ability to predict physics grades for black Americans can be improved by considering males and females separately, since Sample an Seymour (1971) and Farver, et al (1973) found that grades of black females could be predicted more accurately than those of black males. Additional study of the relationship between ability to predict and sex would be of value to those interested in correcting the underrepresentation of either minority groups or females in science-related fields. Further investigations regarding the apparent relationship between ACT English score and physics grade would also be of considerable interest.

(3) What implications can be drawn from comparison of this study with past investigations?

Previous investigations show that procedures like those used in this study have value in predicting the academic performance of (presumably) majority students in physics at majority institutions. This study shows that the same is true for black students in physics at a predominantly-black institution. The question of whether or not these measures predict for black students at majority institutions is open to question, but there is evidence to suggest that they do not (Temp, 1971; Borgen, 1972). If so, the question of why not is of some importance, both to those interested in the interpretation of studies of this

type, and to those concerned with the specific academic difficulties experienced by minorities.

The authors propose, given the results of numerous studies of this type cited above, that values of R in the 0.45 to 0.65 range are to be expected when predicting grade in lower level college courses with traditional indicators. Predictor studies may then serve as a warning system. Lower R values could indicate that a noncognitive factor, possibly a cultural one, is interfering with the academic process. If so, predictor studies could provide direction as individual schools seek to improve minority performance/retention in science programs. If predictor studies yield relatively high R values, it is likely that greatest improvement can be made by emphasizing traditional tutoring and prerequisite skills development. If, on the other hand, R values are low, perhaps equal emphasis should be placed on developing support systems which attempt to deal with and, where possible, overcome the interfering non-cognitive factors. Research is needed to identify the specific non-cognitive factors which lead to the failure of traditional academic indicators on individual campuses, so that support strategies can be tailored to local conditions.

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